

REMARKS

Claims 1, 3-6, 10, 12, 14, 15, 25, 28, 29, 33, 36, 40, 42, 47, 50, 68, 76, 78, 81 and 82 are now pending in the application. Claim 4 has been amended to correct a typographical error. Support for the foregoing amendments can be found throughout the specification, drawings, and claims as originally filed. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

Claims 1, 3, 5-6, 10, 12, 25, 28, 29, 38, 40, 42, 47, 81 and 83 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tourle (GB 2,338,212).

Claims 4 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tourle (GB 2,338,212) in view of Suzuki et al. (JP 2003-285423).

Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tourle (GB 2,338,212) in view of Ohyama et al. (U.S. Pat. No. 5,394,059).

Claims 33, 76 and 78 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tourle (GB 2,338,212) in view of Wen (U.S. Pat. No. 6,092,890), and further in view of Codos (U.S. Pub. No. 2002/0044188).

Claims 36 and 68 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tourle (GB 2,338,212) in view of Nakamura (U.S. Pat. No. 6,129,464).

Claims 50 and 82 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tourle (GB 2,338,212) in view of MacQueen (U.S. Pub. No. 2003/0129369).

These rejections are respectfully traversed.

The claims relate to printing using curable ink. In particular, the claims relate to printing using curable ink where the image to be printed is formed by depositing more than one pass of ink on the substrate.

In some printing operations, it is possible to print the desired image in a single pass: with one movement of a printhead arrangement relative to the substrate. However, in many printing operations, it is necessary or desirable to build up the printed image in a plurality of passes.

Where the image is built up in multiple passes, problems can occur. For example, when printing with curable ink (in particular where the ink is printed onto a non-absorbent or low-absorbency substrate), the printed ink has a tendency to pull up from the surface, forming balls or ridges of ink which can lead to undesirable visible artefacts in the printed image. In attempt to reduce such a problem, the inventor recognized that by applying radiation to the printed ink after deposition to effect cure of the ink, the "pull-up" can be reduced or eliminated, thus reducing the formation of balls or ridges.

The inventor has further identified that it is often the case that the surface energy of the cured ink is different from that of the original substrate onto which the first pass of ink was printed. The inventor has identified that this can lead to a further problem in the case of multi-pass printing.

In multi-pass printing, ink of a first pass may be printed and then a curing step carried out to cure the ink of the first pass. Subsequently, ink of a second pass of the printing is applied and may be applied onto ink which was applied during the first pass of printing and/or to an area of the substrate onto which the ink of the first pass was not

deposited. Because the surface energy of the ink which was applied during the first pass of printing may be different from that of the unprinted substrate, the ink of the second pass may display a different behavior depending on where it has been deposited: on an area of unprinted substrate, or on an area on which the ink of the first pass has been printed and cured. This may lead to further risk of surface artefacts being formed and being visible in the final printed image.

The inventor of claim 1 has surprisingly found that by carrying out a partial cure such that an exposed surface of the ink is in non-solidified form (as defined in claim 1), the behavior of the ink droplet of the second pass can be improved. For example (but without wishing to be bound by any particular theory), because the surface of the ink of the first pass is non-solidified, there is better wetting of the ink of the first pass by ink of the second pass compared with the wetting of cured ink.

In paragraph 3 of the Official Action, the Examiner has cited GB2338212 Tourle to render obvious certain claims.

Tourle at best appears to show a printing apparatus for printing onto a substrate using UV curable ink. As shown in Figure 2, ink is deposited onto the substrate using a printhead 11, and is subsequently cured using a UV source 16. After the ink is deposited, the ink is "exposed to the ultraviolet light ... to ensure the ink is cured before the next color is applied" (see Abstract of Tourle).

In the passage at page 9 lines 11 to 13 identified by the Examiner, it is stated that the "substrate is subsequently exposed to the ultra-violet lamp 16 on each rotation of the drum 14 to cure the ink before the next color is applied" (emphasis added). As

indicated above curing a first pass of ink before a second pass is applied can lead to problems with different behavior of ink deposited onto different areas of the substrate.

Claim 1 recites "partially curing the ink deposited in the first pass such as an exposed surface of the partially cured ink is in non-solidified form; depositing a second pass of ink using radiation curable ink on the area." The Examiner has correctly identified that there is no teaching in Tourle that the exposed surface of the partially cured ink is in non-solidified form as required by claim 1. Applicant submits that there is no suggestion in Tourle that the ink would be subject to partial curing such that an expose surface of the partially cured ink is in non-solidified form.

Firstly, the teaching of Tourle is that the ink of the first pass should be cured before the next pass of ink is applied. For example, the passage at page 9 lines 5 to 8 indicates that the cure should be carried out so that the ink is prevented from "smudging, running ... ". Thus the teaching of Tourle is that the surface of the cured ink is not nonsolidified as required by claim 1 of the present application.

Furthermore, there is nothing in Tourle to suggest to the skilled person that it would be desirable for the surface of the partially cured ink to remain non-solidified. There is no suggestion in Tourle that the printing of a second pass of ink onto a first, cured, pass of ink may be Tourle. Indeed, the teaching of Tourle is that such curing of the ink must be sufficient to "prevent it smudging, running or otherwise traveling" (page 9 line 5 of Tourle). Thus Tourle teaches away from a partial cure leaving an exposed surface of the ink which is non-solidified. Further, the Examiner has conclusorily asserted that "it would be obvious to one of ordinary skill in the art to balance the time cost and the amount of curing to leave the ink in gel-like form which would make it

resistant to travel, but save time and maintain printing speed.” Applicant respectfully requests the Examiner to cite prior art references to demonstrate that it is within the knowledge of one of ordinary skill in the art to form the alleged “gel-like” ink in order to maintain printing speed.

Thus, Applicant submits that claim 1 defines over the art cited by the Examiner.

Claim 29 recites features similar to the above distinguishing features of claim 1 and, thus, also defines over Tourle for similar reasons. As above, it is noted that the teaching of Tourle that the curing of the ink must be sufficient to “prevent it smudging, running or otherwise traveling” is required (page 9 line 5 of Tourle). As indicated above, the inventor has found that in examples of printing where a first pass of ink is cured so that the exposed surface is solidified before a second pass of ink is printed, the cured ink of the first pass is not substantially wettable by the ink of the second pass. Thus there is no disclosure or suggestion in Tourle of the invention of claim 29.

Claim 38 recites features similar to the above distinguishing features of claim 1 and, thus, also defines over Tourle for similar reasons as for claim 1.

In view of the foregoing, Applicant submits that claims 1, 3-6, 10, 12, 14, 15, 25, 28, 29, 33, 36, 40, 42, 47, 50, 68, 76, 78, 81 and 82 define over the art cited by the Examiner.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is

believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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